Egyptian Pioneer Schools

Preparatory 3
Science – Booklet
First Term

Academic year:
2019/ 2020

SCIENCE DEPARTMENT

Science and life

Discover and learn

Third preparatory Booklet

Unit 1 : *Force and motion*

Lesson 1: *Motion in one direction*

Concept of motion:

The change of an object's position as time passes according to the position of another object.

The simplest type of motion is the motion in one direction, such as the movement of the train which moves forwards or backwards but it doesn't move upwards or downwards. If the path of the train is straight so the movement of it will be straight line in one direction motion.

-Speed is the physical quantity that distinguishes the description of objects either fast or slow.

-There are two factors necessary to describe the movement:

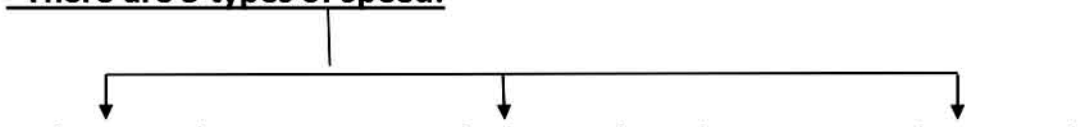
So, speed is:

The distance covered in a unit time.

If an object covers a distance (Δd) with a short time span (Δt), then the speed of this object (V) is:

$$V = \frac{\Delta d}{\Delta t} =$$ .....meter/ second (or km /hour)

***There are 3 types of speed:**



1 Uniform Speed:

- **It means that the object covers equal distance in equal periods of time.**
- **Ex:** if the speedometer in the car point to 72, this means that the car covers 72 km/hour , if this reading is still constant this car then will has a uniform speed.
- The unit for measuring the uniform speed is (meter/second) or (km/hour).
- When the speed is regular the object cover equal distance in equal periods of time. So,

$$V = \frac{d}{t}$$ for regular speed only

2 Irregular (average speed): $\overline{V}$

- If we observe a car movement on a road, we find that its speed changes according to the traffic. In this case this car moves in Average speed.
- ***Average speed:***

  The total distance that the moving object covers divided by the total time taken to cover this distance.

$$Average\ speed\ V = \frac{total\ distance\ covered\ (d)}{total\ time\ (t)}$$

- Average speed represents the regular speed by which the moving object moves to cover the equal distance at the same period of time.

Uniform speed	*Non-uniform speed*
If the object moves with a uniform speed, then its average speed = its uniform speed. $V=\overline{V}$	when the object covers equal distance at unequal periods of time, or covers unequal Distance in equal periods of time.

➢ ***EX:*** a runner covers 100 meters in 10 seconds, and he walking back to cover the same distance in 80 seconds so,

- ***His average speed while running***

$V = \frac{d}{t} = \frac{100}{10} = 10$ meter/second

- ***His average speed while returning back:***

$V = \frac{d}{t} = \frac{100}{80} = 1.25$ meter/second

- ***His average speed in the whole trip:***

$V = \frac{d}{t} = \frac{200}{90} = 2.2$ meter/ second

❸ Relative speed:

➢ ***The speed of the moving object relative to the observer.***

➢ This means that measuring the speed depends on the position of the observer who determines the magnitude of the observer.

➢ This means also that the car's speed relative to the observer standing on the ground differs from the value of the car's speed relative to an observer in another moving car.

➢ ***Ex:*** if there are 2 cars moving in one direction. The first one moves in 80 km/hour and the second one moves in 90 km/hour, So:

- The speed of the two cars relative to the observer standing on the ground = 80 &90 km/m
- The speed of the fast car relative to the passenger of the slow car = 10 km/m.

Quiz ①

Q. (1): Write the scientific term:

1. The displacement covered in unit time. (.....)
2. The velocity when the body covers equal distances In equal intervals of time.(.....)
3. The movement in straight lines. (.....)
4. The change in the position of the body by the time relative to the position of another body. (.....)
5. The product of the velocity of the body X the time. (.....)

Q. (2): Calculate:

1. Booing plane traveled from Aswan airport to Cairo airport through one hour, it covers a distance of 1000 kms. Calculate the reading of the speedometer by km/hour and m/s, given that the plane moves by constant velocity.

.....

.....

2. A boy on a bike covers 300 km in a minute and 240 meters in the next minute. Calculate its average speed:
   - During the first minute.
   - During the second minute.
   - Within the two minutes.

.....

.....

Q. (3): What's meant by:

1. The average speed of a moving car is 70 kms/hour.

.....

2. A moving car covers a distance of 100 kms in two hours.

.....

3. The distance covered by a body is changed by 2 meters each second.

.....

4. The body moves in irregular speed.

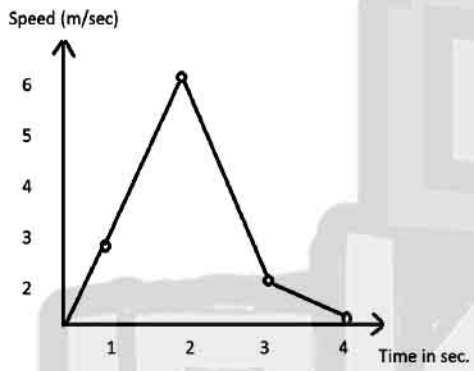
.....

Lesson 2: Graphic representation of moving in straight lines

Mathematical relations used in: (graphs and tables)

1. Describe a specific physical phenomenon by finding the mathematical relation between different variables and understand the practical results.
2. Understand practical results of certain physical phenomenon.
3. Predict the relation between certain physical quantities.

Ex: ***The relation between the speed and time of a moving car.***



- The car start to move from rest (speed = zero).
- After 1 second its speed becomes 3m/sec.
- After another second its speed increases to be 6m/sec.
- In the third second the driver had to use the brakes to slow down the speed to decreases to 2 m/sec.
- Then the car stopped again (speed = zero).

*Representing the uniform speed graphically:

➢ ***Tools:***

1.A toy car operated by a battery 2.Smooth wooden board about 2 meters long

3.Meter ruler or metric strip 4. Stop watch

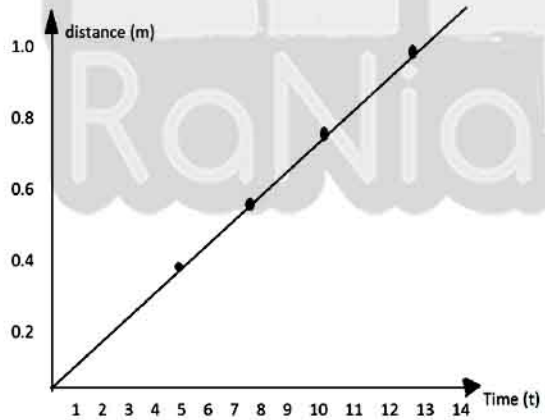
➢ ***Procedures:***

1. Place the wooden board in horizontal position and put two marks on it and measure the distance between them.
2. Operate the car, then measure the time (t) taken to cover the distance.
3. Repeat the experiments changing the two marks.
4. In each time calculate the speed of the car.
5. Put your result in a table.

To draw the graph:

- ✓ Put the distances (d) on the vertical axis (Y-axis).
- ✓ Put the time (t) on the horizontal axis (X-axis).
- ✓ Put your readings as a dots and then join them with a line.

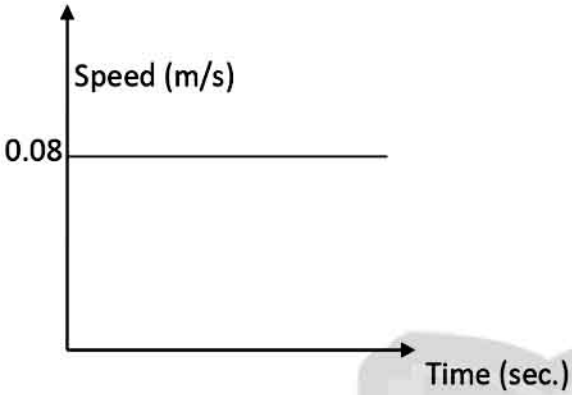
The number of trials	The covered distance (d) m	The time taken (t) sec.	The speed m/sec
1	0.4	5	0.08
2	0.6	7.5	0.08
3	0.8	10	0.08
4	1.0	12.5	0.08



*__From this graph you can conclude:__

- **The distance is directly proportional to the time at uniform speed.**
- The relation between the distance and the time at uniform speed is represented by a **straight line passing through the origin point.**

- The relation between the speed and time at uniform speed is represented by a **straight line parallel to the time axis.**



*Acceleration:

- **The changing in the object's speed in one second.**
- If a moving car increases its speed with 3m every second this called ***Acceleration Motion.***
- If the car decreases its speed each second until it stops, then this motion is described as ***Decreasing Acceleration.***

$$\textbf{Acceleration } (a) = \frac{\textbf{change in speed } (\Delta V)}{\textbf{time } (\Delta t) \textbf{in which change occurs}}$$

$$\textbf{Acceleration } (a) = \frac{\textbf{final speed } (V2) - \textbf{ initial speed } (V1)}{\textbf{Time } (\Delta t)}$$

- The acceleration unit= $\frac{\frac{Meter}{second}}{second}$ = **meter/second^2.**
- Acceleration increases when the speed increases by time, and decreases when speed decreases by time.

➢ **Uniform acceleration :**

-When the object's speed changes (increases or decreases) by equal values in equal periods of time.

-Ex.: The coming readings are a moving object recorded every 5 seconds.

Time (t)sec	Speed (V) m/sec
0	0
5	10
10	20
15	30
20	40
25	50
30	60

From this table:

- The object's speed increases regularly during movement.
- The value of increasing every 5 second is 10.
- The value of increasing every second = $\frac{10}{5} = 2$.
- The value of acceleration = $\frac{V2-V1}{t} = \frac{60-0}{30} = 2$ m/sec ^{2}.

Deceleration motion:

- In the case of decreasing the speed (which means the value of V2 is smaller than the value of V1), the motion described as deceleration motion.
- In this case we use the following law to find the acceleration:

$$\textbf{acceleration} = \frac{V2-V1}{t}$$

Quiz ②

Q. (1): calculate:

1. On a straight line there is a moving bus whose speed changes from 6 m/sec to 12 m/sec during a period of 3 seconds, what is the value of acceleration.

.....

.....

2. A driver used the brake to stop the car moved by 20 m/sec. calculate the time taken by the car to stop. Given that the acceleration of the body equals 1 m/sec^2.

.....

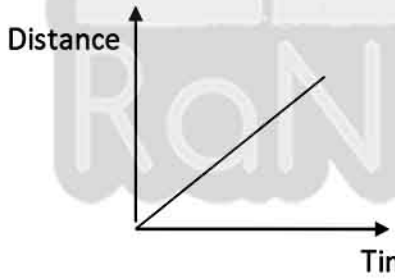
.....

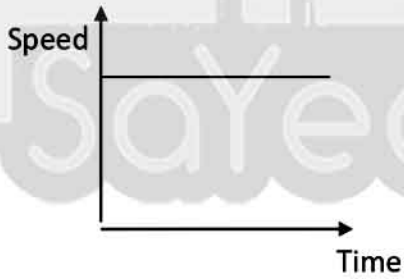
3. If a boat starts to move from rest till its speed become 2.5 m/sec through 5 seconds. ***Find:***
   - The acceleration of the moving boat.
   - The type of the acceleration, give reason.

.....

.....

Q. (2): describe the motion of the body in each of the following graph:





.....

.....

Q. (3): complete:

1. The uniform acceleration is ..... .
2. If a moving car decreases its speed every second until it stops, this motion is described as ..... .

3. The speed- time relation for regular motion at uniform speed is represented by ..... parallel to the ..... axis.
4. Acceleration unit is ..... .

Q. (4): A moving car starts from rest and then its speed increases to 15 m/sec through 5 sec. and another car whose movement starts from rest and increases to 20 m/sec through 10 sec. Which of the two cars is moving at greater acceleration?

.....

.....

Lesson 3 : Physical Quantities (Scalars and Vectors)

Each physical quantity is related to a measurement unit that characteristic to it

All physical quantities are classified into two types :

*Scalar's quantity:

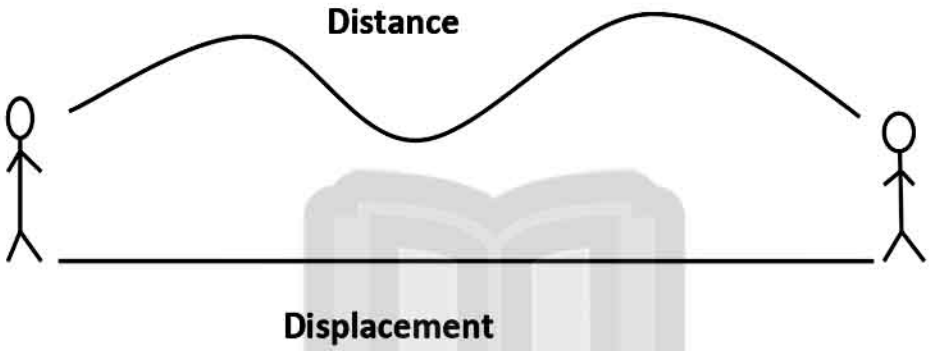
- ***It is enough to identify its magnitude only by giving its numeric value and measuring unit.***
- It is the quantity that has magnitude only and it has no direction.
- Ex: Mass ⟶ kilogram
  Length ⟶ meter
  Time ⟶ second
- All scalars are subject to algebraic mathematical operations related to numbers and specially they are added or subtracted if they have the same measurement units.

*Vectors quantity:

- ***It is not enough to identify its magnitude only by giving its numeric value and measurement units, but also a direction as well.***
- It is the quantity that has a magnitude as well as direction.
- Ex: Force , Acceleration, Velocity , displacement.
- All vectors are subject to mathematical operations called Vectors Algebra.
- Vectors are important in:
  - Different fields of physics and applied science like engineering.
  - Understanding various physical phenomena such as gravity, movement of liquids.
  - Geometrical establishment depend basically in on the main properties of vectors.

*Distance and displacement:

- When an object moves, that means there is changing in its position. This change does not depend on the path of the object but depend on the shortest path between the start position and the end position



- Ex: if a person want to make a trip by car from Cairo to Tanta, he can take 3 paths:

Cairo - Benha – Tanta	***Cairo – Tanta***	***Cairo – Zagazig – Tanta***
Distance is 105 km	Distance is 93 km	Distance is 165 km

From the previous example:

- Cairo represents the start position while Tanta is the end position.
- Cairo – Benha – Tanta movement is a possible distance of the moving car.
- Cairo – Zagazig – Tanta is another possible distance.
- Cairo – Tanta straight (direct) distance represent the displacement of the car when moving from Cairo to Tanta. In this trip the displacement = the distance.
- Displacement is characterized by both magnitude and direction.

Displacement :

The length of the shortest straight line between two positions at certain direction.

Distance :

The actual length of the path that a moving object takes from the start point of the movement to the end point

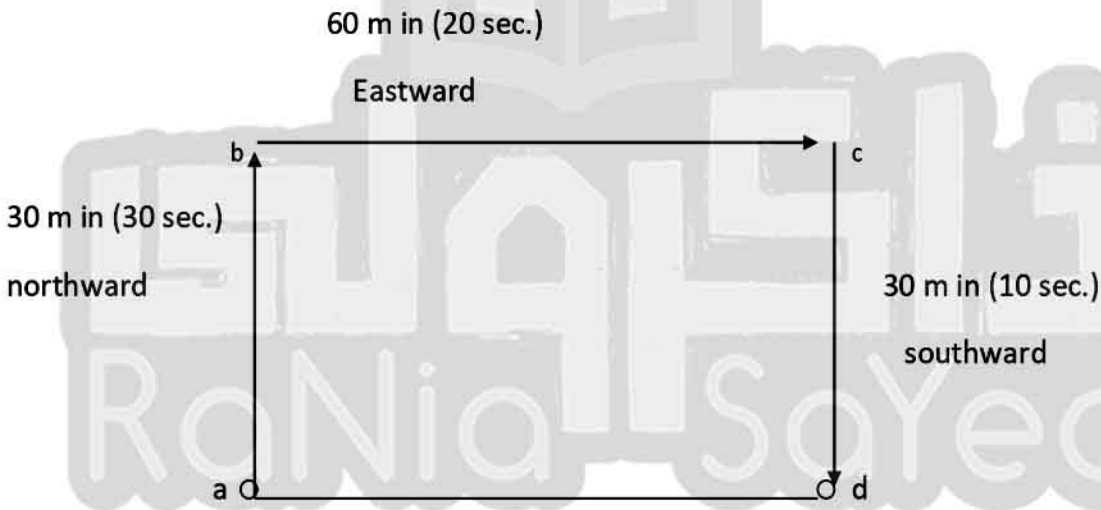
*Velocity:

- ***It is the speed in a given direction.***
- To determine the velocity we have to know the value of the speed and its direction.
- Ex: to know the velocity of a running cheetah we have to know the direction of its movement. We say that the velocity of the cheetah is 27 m/sec in the west direction for example.
- The velocity is a vector quantity.
- $V = \frac{Displacement}{Total\ time}$ = m/sec. or km/hour (the same units of speed).

Velocity :

The displacement in one second and certain direction.

- ***EX:*** if a person moves on a path a ⟶ b ⟶ c ⟶ d, as shown in figure:



- The start point is (a).
- The end point is (d).
- The value of total distance covered by the person = 120 m.
- The total time taken to covered this distance = 60 sec.
- The direct line between (a) and (d) represent the displacement from point (a) to point (d).
  Displacement = 60 m in the eastward direction.
- The average velocity = $\frac{Displacement}{Total\ time} = \frac{60}{60}$ = 1 m/sec. in the direction of eastward.

*Science technology:

- To calculate the time that taken by light to reach the Earth from the sun, we can use the relation $V=\frac{d}{t}$.
- We take into consideration that light travels in constant regular speed in the space.
- If the sun is 149000,000 km away from the Earth and if the speed of light is 300,000 km/sec.

  Speed of light = $\frac{Total\ distance\ covered}{Total\ time}$

  Time = $\frac{Total\ distance\ covered}{light\ speed}$ = $\frac{149000000\ km}{300000\ km/sec}$ = 497 second approximately = 8 minutes and 27 seconds.
- Which means that if the sunset is 5 o'clock, the light travelled from the sun at 4:51:30.

Technological application:

- ***On their flights, pilots take into consideration the velocity of the wind in order to calculate the amount of fuel necessary to complete the trip.***
- ***EX:*** If two planes make a trip (covering the same distance):
  1. The first one travel in the opposite direction of the wind, so it needs a larger amount of fuel as the wind resistance will be higher.
  2. The second one travels back at the same trip. It travels with the wind direction, so it will use smaller amount of fuel as the wind resistance is lower.

Quiz ③

Q. (1): Complete:

1. ..... is the covered distance in a constant direction and is a vector quantity.
2. ..... is the value of displacement at a unit time and is a vector quantity.
3. ..... and ..... are from scalar physical quantity.
4. The displacement of the body through an interval time does not depend on the distance but depends on ..... .
5. ..... is the quantity that its magnitude and direction are necessary for identifying it.

Q. (2): A racer covered 50 m northward within 30 sec. then 100 m eastward within 60 sec. then 50 m southward within 10 sec, and then return back to the start point in 40 sec:

1. How long is the total distance the racer moved?
   .....
2. What is the average speed of the racer?
   .....
3. What is the displacement? What is the velocity?
   .....

Q. (3): Give reasons:

1. The velocity is a vector physical quantity.
   .....
2. Physicists using mathematical methods like graphics and tables.
   .....
3. Pilots take in consideration the velocity of the wind.
   .....
4. The distance is a scalar physical quantity.
   .....

Q. (4): What's meant by:

1. The distance that covered by a travelling car is 60 km.

   .....

2. The displacement between Cairo and Tanta city is 93 km.

   .....

Unit 2: Light Energy (mirrors and lenses)

Lesson 1: Mirrors

When you look at the still water or a mirror, you can see the image of your face. This is due to light reflection.

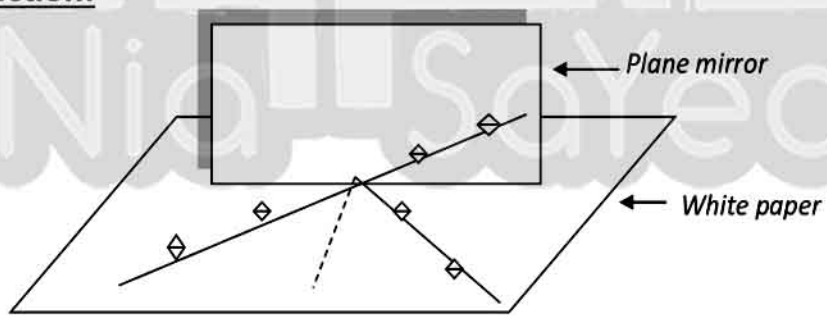
❶ *Plane Mirror:*

*** The properties of the image formed by the plane mirror:**

- Put a plane mirror on a vertical position and a card with some letters written on it in front of the mirror to know its properties.

1. The image is ***upright.***
2. The image is ***equal to the object.***
3. The image is ***laterally inverted.***
4. The image is ***virtual*** image (cannot be received on a screen).
5. The distance of the object to the mirror = the distance of its image to the mirror.
6. The straight line connecting the object and its image is perpendicular on the surface of the mirror.

***Laws of light reflection:**



- ***Materials:***
  A plane mirror - White paper sheet - Pins - Protractor - ruler.
- ***Steps:***
  1. Draw a straight line on the white sheet (XY) and put the mirror margine exactly on it. Draw a perpendicular line (OD) as shown (the normal).
  2. Draw a straight line (AO) and put 2 pins on it (p1) and (p2).

3. Look at the image of the two pins and put another 2 pins (p3) and (p4) as straight as the image of (p1') and (p2').
4. Connect between (p3) and (p4) with a straight line extending to the reflecting point (O), (OB) line.
5. Measure the angle of incident (between AO and the normal) and the angle of reflection (between BO and the normal).

- **Conclusion:**

***Law* ❶: Angle of incident = Angle of reflection**

***Law* ❷: The incident light ray, the reflected light ray and the normal all lie in the same plane which is perpendicular to the reflecting surface.**

*Concepts related to light reflection:

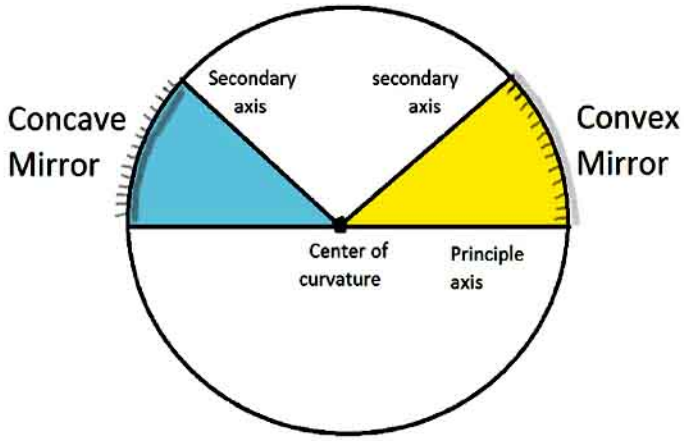
1. ***Light reflection:*** the bouncing of incident light ray in the same medium when it met a reflecting surface.
2. ***The incident ray:*** the light ray that alls on the reflecting surface.
3. ***The reflected ray:*** the light ray that bounces from the reflecting surface.
4. ***Angle of incident:*** the angle between the incident ray and the normal at the point of incidence.
5. ***Angle of reflection:*** the angle between the reflected ray and the normal at the point of incidence.

❷ *Spherical Mirror:*

It is a mirror that its reflecting surface is a part of a hollow sphere.

***Types of spherical mirrors:**

Concave mirror	***Convex mirror***
Where the reflecting (shining) Surface is a part of the inner surface of the sphere.	Where the reflecting (shining) surface is a part of the outer surface of the sphere.



*Concepts concerning the spherical mirror:

1. ***Centre of mirror curvature (C):*** the centre of the sphere that the mirror is considered a part of it.
2. **Centre of curvature of convex mirror is behind the reflecting surface.**
3. **Centre of curvature of concave mirror is in front of the reflecting surface.**
4. ***The radius of curvature of the mirror (r):*** the radius of the sphere that the mirror is a part of it.
5. ***The pole of the mirror (p):*** the point that is in the middle of the reflective surface of the mirror.
6. ***The principle axis (cp):*** the straight line that passes by the pole of the mirror and its centre of curvature.
7. ***The secondary axis:*** any straight line that passes by the centre of curvature of the mirror and any point on its surface except the pole of the mirror.

*The focus of the concave mirror:

The point at which the incident light rays, that falls from distance object, are collected when it falls on a concave mirror.

*The focal length of the concave mirror(f):

- ***Materials:***
  A concave mirror – screen.

- ***Steps:***
  1. Place a concave mirror facing the sun.
  2. Move the screen in front of the reflecting rays from the mirroe until you get the clearest smallest image (Light spot).
  3. Measure the distance between the mirror pole and the image, this will be the focal length of the mirror.
- ***Conclusion:***
  1. The rays after reflected from the concave mirror is collected in one point.
  2. The focus of the concave mirror: the point of the collection of the parallel rays after being reflected from the concave mirror.
  3. The focal length of the concave mirror: the distance between the focus of the mirror and its pole.

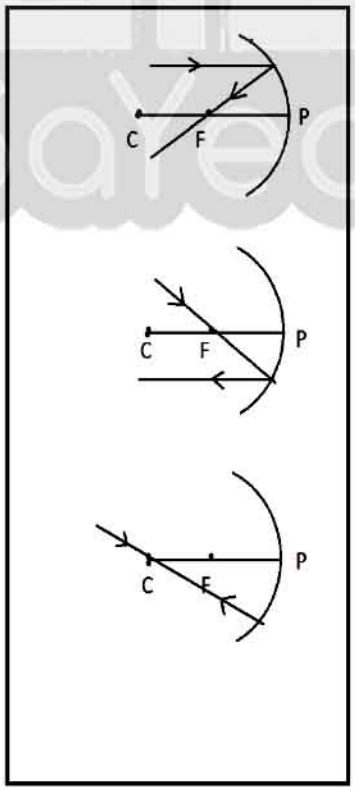
The focal length (f) = $^1/_2$ X radius of curvature = $^1/_2$ R

*Rules to determine the direction of the reflecting light rays incident on the concave mirror:

1) The incident light ray parallel to the principle axis of the mirror, reflects passing through the focus.

2) The incident light ray passing through focus (f) will reflect parallel to the principle axis.

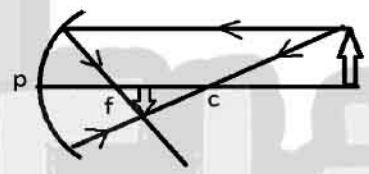
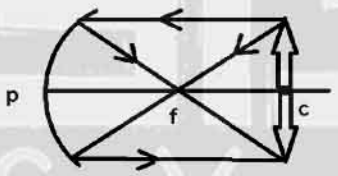
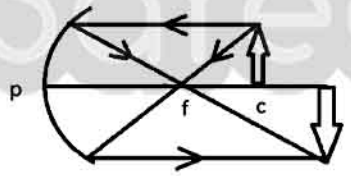
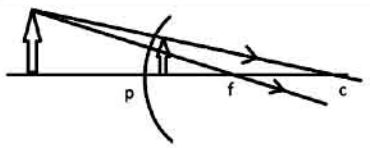
3) The incident light ray passing through the centre of curvature of the mirror reflects back on itself.



You can determine the position and properties of the image by using only two of these rays.

The Real Image	*The Virtual Image*
• The image that can be formed on a screen. • It is always inverted • Formed by the intersection between reflected light rays	• The image that cannot be formed on a screen. • It is always upright • Formed by the intersection between the extension of light rays

***The properties of the image formed by the concave mirror:**

Position of the object	*Position of the image*	*Properties of the image*	*The cases of image formation*
At a distance greater than the radius of curvature.	Between the focus and the centre of curvature.	Real, inverted, and diminished image	
At the centre of the curvature.	At the centre of the curvature.	Real, inverted, and equal to the object.	
Between the focus and the centre of curvature.	At a distance greater than the radius of curvature.	Real, inverted, and enlarged.	
Between the focus ant the pole of the mirror.	Behind the mirror.	Virtual, upright and magnified.	

***The formation of the image on a convex mirror:**

The image of the object placed on a convex mirror is **always smaller than the object upright and virtual** even of the distance of the object is changed from the convex mirror.

Quiz ④

Q. (1): Complete:

1. The reflecting surface of a convex mirror is a part of ..... sphere.
2. The radius of curvature of the convex mirror equals ..... its focal length.
3. ..... is the image that can be received on a screen.
4. The phenomenon of the light bouncing off in the same medium when meets the reflecting surface is called ..... .
5. The incident light ray parallel to the principle axis of the concave mirror, it will reflect passing through ..... .

Q. (2): Choose:

1. A body is placed in front of concave mirror at a certain distance from its pole and no image is formed on the screen, this is due to the body is:

- Transparent
- Placed at infinite distance in front of the mirror.
- Opaque
- Placed at a distance less than the focal length.

2. If the focal length of a concave mirror equal 10 cm, to obtain a virtual image, the body is placed at a distance from the mirror pole equals:

- 10 cm
- 15 cm
- 20 cm
- 5 cm

3. A concave mirror with a focal length of 20 cm and the object is placed at a distance of 50 cm from the mirror, the image is formed at a distance:

- More than 40
- More than 20 cm and less than 40 cm
- Equals 20

4. When the object is at the centre of the curvature of a concave mirror, the image is:

- Real, inverted, and is diminished.

- Real, inverted, and equal to the object.
- Virtual, inverted, and enlarged.

5. A spherical mirror with radius 60 cm, its focal length will be:

- 60 cm - 120 cm - 30 cm

Lesson 2: *Lenses*

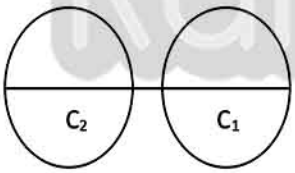
*The lens:

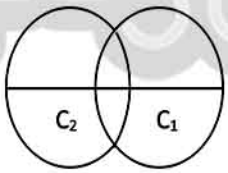
A transparent medium that refract the light and is defined with two spherical surfaces and is usually made of glass or plastic.

*Types of lenses: there are many types, of them:

Name of the length	**Convex lens (Converging)**	**Concave lens (Diverging)**
Definition	-It is thick from the centre and less thick at the tips. -The function of the convex lens is to collect the light rays falling on it.	-It is thin at the centre and more thick from the tips. -Its used in diverging the light ray falling on it.
The shape of the lens		

*Special concepts of the lenses:





1. ***The centre of the curvature of the lens face (c)*** :
   The centre of the sphere where the face part of it.
2. ***The optical centre of the lens (p):***
   A point inside the lens lies on the principle axis in the mid distance between its faces.
3. ***The radius of curvature of the face of the lens (r):***
   Half the radius of the sphere the face part of it.

4. ***The principle axis:***

The line between the centers of curvature of the lens passing by the optical centre of the lens.

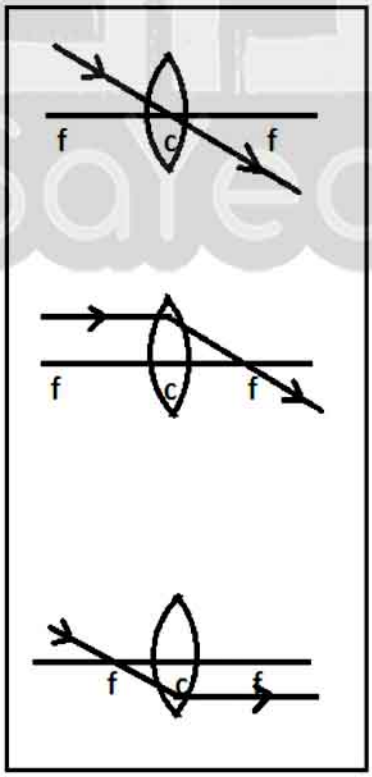
1 *The convex lens:*

- **The focus of the convex lens:**
  The point at which the light rays falling on the lens are collected.
- The convex lens form a real, inverted, smaller image of the object.
- **The focal length of the convex lens:**

- Place a lens on a holder in front of a distant light source.
- Place a screen on the other side of the lens, keep moving the screen until you get the best image (light spot).
- Measure the distance between the point and the optical centre of the lens, this distance will be the focal length (f).

- The light rays passing through the convex lens converge to a point called the focus of the lens, that's why the convex lens is called converging lens.
- ***The three rules to determine the direction of the light ray after passing through the lens:***

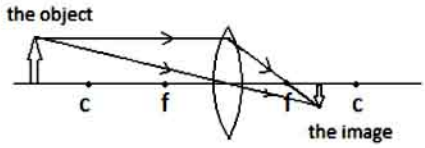
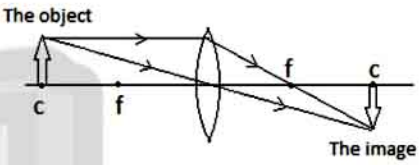
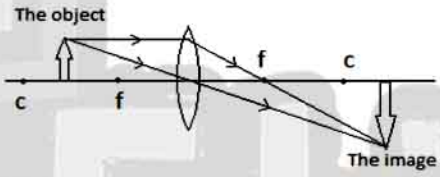
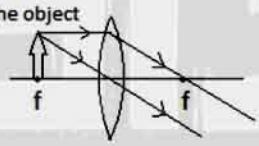
1. The incident light ray passing through the optical centre of the lens, passes through the lens without refraction.



2. The incident light ray parallel to the principle axis, exits from the lens passing through the focus.

3. The incident light ray passing through the focus, exits from the lens parallel to the principle axis.

- ***The position and properties of the image formed by the convex lens according to the position of the object:***

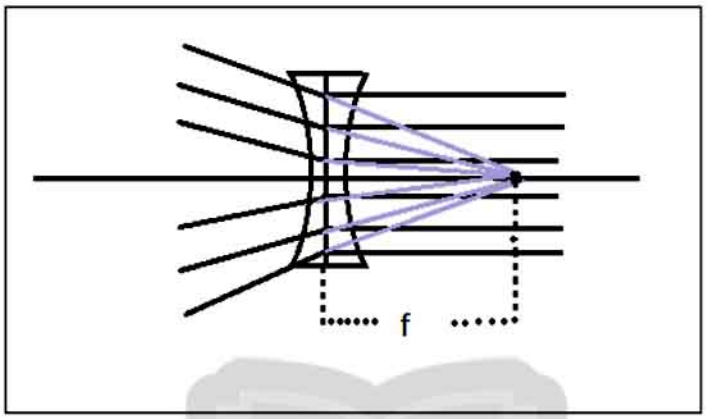
Position of the body	Position of the image	Properties of the image	Cases of image formation
Greater than twice of the focal length	Between the focus and twice the focal length	Real, inverted, and diminished	
At twice the focal length	At twice of the focal length	Real, inverted and equal to the object	
Between the focus and twice the focal length	At a distance greater than the twice of the focal length	Real, inverted and magnified	
At the focus	At the infinity	The rays exit parallel	
At a distance smaller than the focal length	At the infinity	Virtual, upright and enlarged	

❷ *The concave lens:*

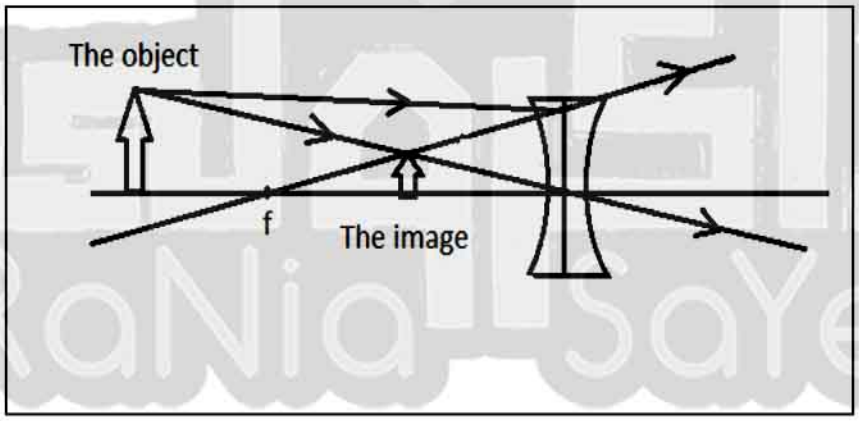
- **The focus of the concave lens:**

  It's a virtual point. When parallel light rays fall on the lens, the lens diverge the rays away from each other as they come from one point, this point is called the focus of the lens.

- The concave lens is called diverging lens as it diverge the light rays away from each other.



- **<u>The image formed by the concave lens:</u>**
  The image is always virtual, smaller, and erect.



***<u>Uses of lenses in treating the vision defects:</u>**

- The normal person sees the object clearly between **25** cm and **6** m.
- The defects of short-sightedness and long-sightedness occur because the eye cornea is not always convex and the eye is not always spherical.

1 Short-sighted:

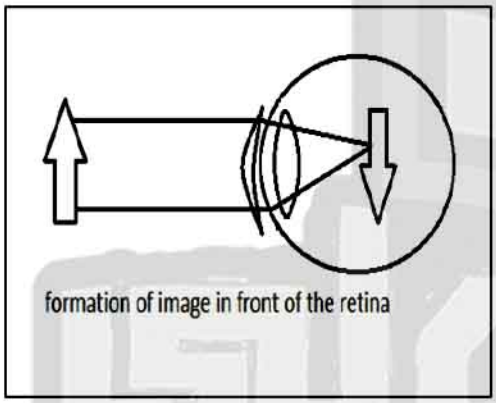
- **When the eye sees the near object clearly, but the far object seem distorted.**

- **<u>This is because the image of these objects do not fall on the retina of the eye but in front of it, this is due to:</u>**

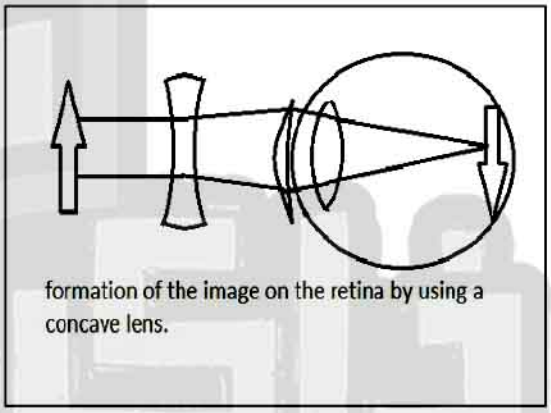
➢ The elongation of the eye ball which causes the retina to be far from the eye lens.

➢ The lens of the eye is more convex which result in a smaller focal lens of the eye lens, so the parallel rays are collected at a point in front of the retina forming un-clear image.

- ***Short-sightedness can be treated by using a concave glasses.***



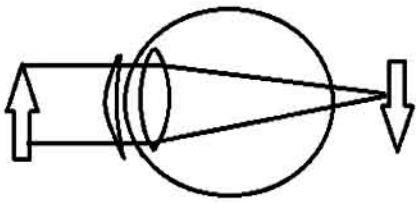
formation of image in front of the retina



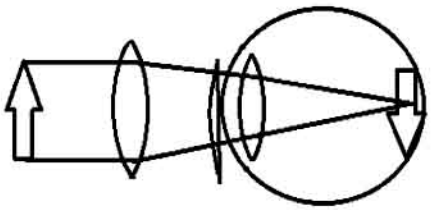
formation of the image on the retina by using a concave lens.

2 Long-sighted:

- **When the eye sees the far object clearly, but the close object are not clear.**
- **<u>This is because the image of the close objects is not formed on the retina but behind it,due to:</u>**
  - ➢ The shortness of the radius of the ball thus the retina is near to the eye lens.
  - ➢ The lens of the eye is less convex which causes the increasing of the focal length, so the rays exiting from the near object are collected at a point behind the retina.



formation of image behinde the retina



formation of the image on the retina by using a convex lens

_ long-sightedness can be treated by using a convex lens, they need to use a medical eye glasses.

*Contact lenses:

It is a very thin lens made of plastic and can stick on the eye by the eye fluids. It is used instead of the eye glasses.

*Land area measurement:

- land surveyors and topographical scientists use a special device to determine the heights and distance accurately by sending a laser beam and calculate the time of its returning back to its lenses and mirrors.

*History:

According to the legend Archimedes used the sunlight as a weapon against the Roman fleet that invaded Sicily in 212 B.C., A huge concave mirror is placed to collect the sun rays and direct them to the Roman ships turning them to a fire balls.

*Cataract disease:

- In this disease the eye lens become opaque.
- This disease is due to the old age, illness, side effect of drugs or genetic readiness.
- This can be treated with a surgery in which the eye lens exchanged by a plastic permanent lens.

Quiz ⑤

Q. (1): Explain the following:

1. The focal length of the thick convex lens is less than that of the thin convex lens.
   .....
2. The concave lens is used to treat a short-sighted person.
   .....
3. The object that is placed at the focus of a convex lens doesn't form an image.
   .....
4. The collective lens has two foci while the collective mirror has one focus.
   .....

Q.(2): Complete:

1. The focal lens of the convex lens equal the distance between ..... and ..... .
2. The concave lens ..... the rays falling on it.
3. A convex lens the distance between its focus and optical centre is 10 cm, so the double its focal length is ..... .
4. The long-sighted person need a glasses with ..... Lens.
5. The vision defect which is due to the shortness in the radius of the eye ball is called .....

Q. (3): Mention the position and properties of the image formed of an object by means of a convex lens in each of the following cases:

1. The object is at a distance larger than the focal length and smaller than twice the focal length.
2. The object is at a distance equal to twice the focal length.

.....

.....

.....

.....

.....

Q. (4): a convex lens has its focal length equal 4 cm. An object is placed at a distance 6cm from the lens. Determine the position of the formed image and its properties by drawing two light rays only.

.....

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Unit 3: The Universe And The Solar System

Lesson 1: The Universe

*What Is The Universe:

- **It is the space which contain all the galaxies, stars, planets, moons, organisms and everything.**
- The universe contains a groups of galaxies (groups of stars are gathered), our galaxy is called Milky Way Galaxy.
- ***Milky Way Galaxy:***
  - It is called so because it appears as a splashing milk or spreading straw in the sky at night.
  - In the centre of the galaxy there are a lot of old stars surrounded by small stars located in the spiral arms of the galaxy.
  - Our sun is a star of million of the stars of the galaxy.

The universe:

It is a wide and extended space that contain galaxies. The number of galaxies in the universe is about 100,000 million galaxies.

- Galaxies are grouped also in clusters.

*The solar system:

- **It is the sun and eight planets revolving around it.**
- Our sun is also revolving around the centre of the Milky Way galaxy. It takes about **220 million years** to complete one rotation around the centre of the galaxy.
- The solar system is located in one of the spiral arms, on the edge of the galaxy.

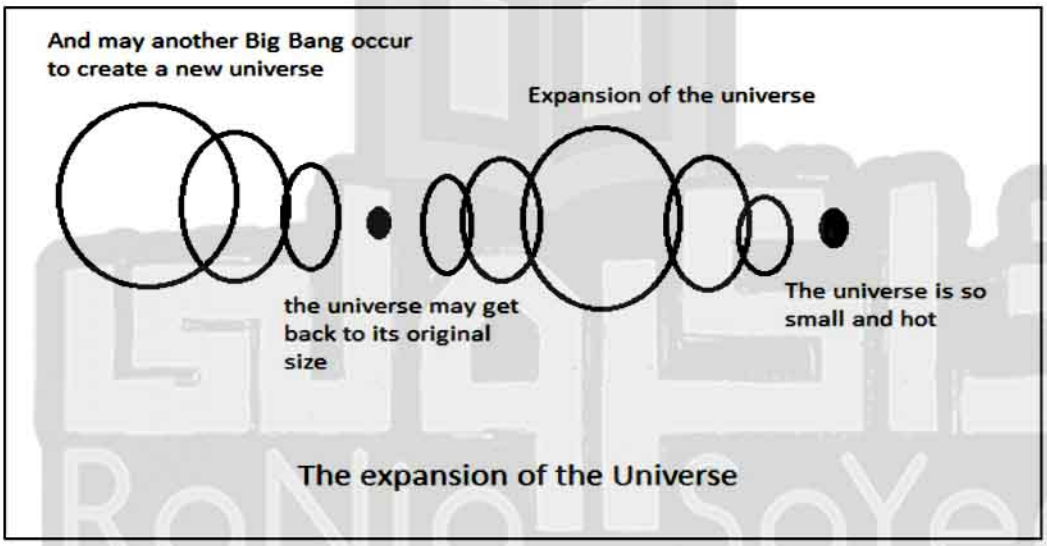
*How did the Universe originate:

- Many scientists believe that our universe is emerged 15000 million years ago by a Big Bang, which is a massive explosion.

- There was no one to record what happened, but the outstanding discoveries in physics and astronomy enabled scientists to trace the history of the universe from the first second fraction of its evolution.

*The Big Bang:

1. Before 15000 million years ago, the universe was a gaseous ball of high pressure and high temperature in a small volume. It is in a constant expansion.
2. After the Big Bang, the expansion and changing started continuous until this day.
3. Within minutes of the explosion, the atomic particles merged together producing helium and hydrogen which over the years produced galaxies, stars, and the universe as we know it today.



The expansion of the Universe

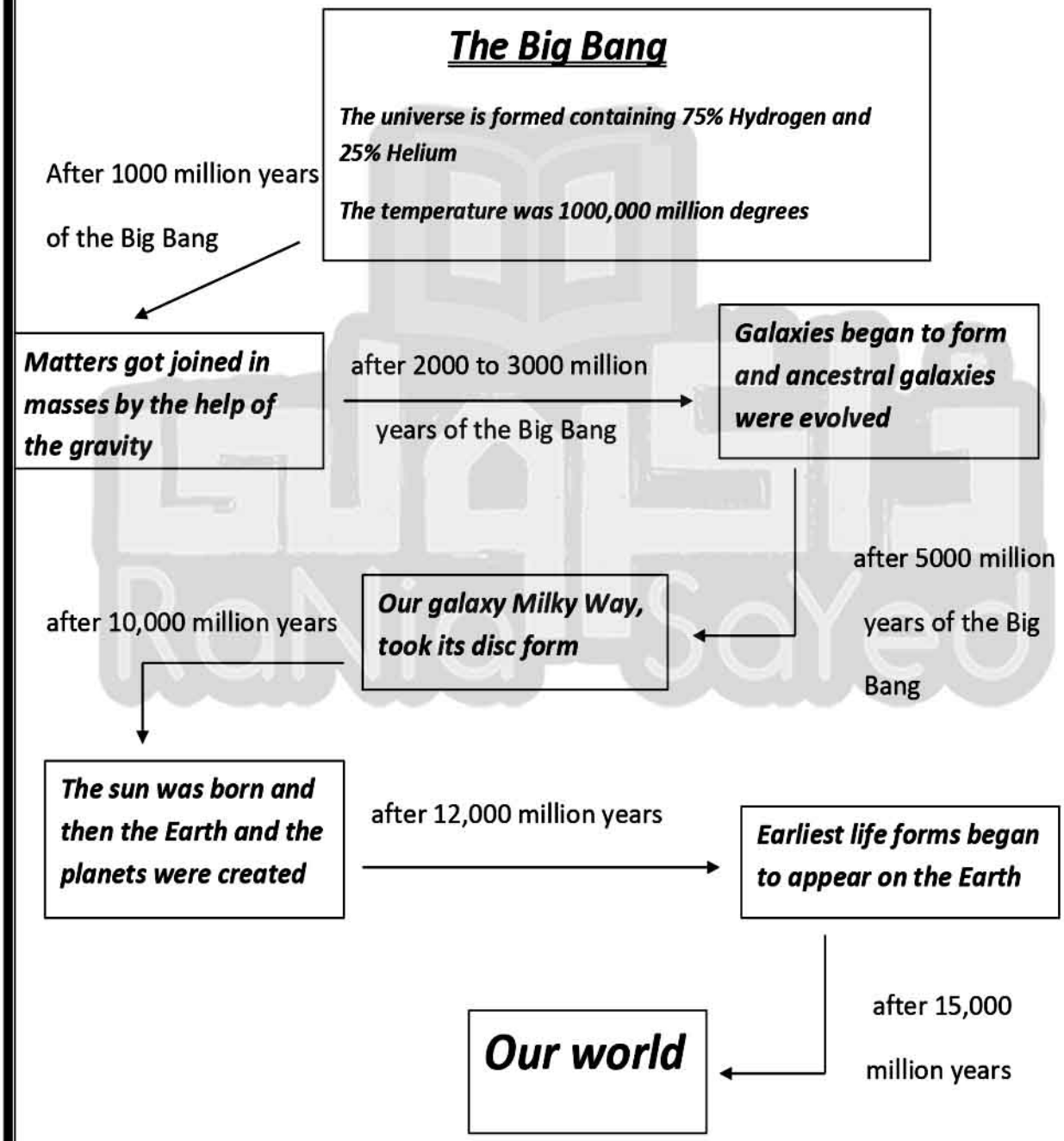
*The Light-year:

Due to the vast distances in the universe, they cannot be measured by km, so **the distance is measured by the light-year which is the distance covered by the light in one year.** As the light speed is 300,000 km/sec so the light-year equal 947,000 million km.

- The universe was almost formed in homogeneous parts.
- But with the expansion process, matter started to merge in masses inside it.
- The gravity helped in gathering of more masses leaving area of empty space between them.
- At the end areas of the gathering matters produced stars and galaxies.

***The defects in the Big Bang theory:**

1. It is not improper with religions.
2. It doesn't explain how could a massive explosion produce this magnificent system, while usually the explosion causes destruction.
3. A person who has not seen the eruption of a volcano but saw the lava moving away from the crater, cannot be sure of the occurrence of the volcanic eruption.



The Solar System

*What is the solar system:

- Millions of years ago the planets were originated in orbits around the sun which is now called the Solar system.
- The astronomic system extend over 12000million km in space and includes asteroids, comets, and moons.
- The sun is the dominant star and represent 99% of the total mass of the system.

*Origination of the solar system:

- 4600 million years ago, planets and other things originated from the matter that remained from the evolution of the sun.
- **The sun nebula:** it's the sphere of gas (mixture of hydrogen and helium) and dust (iron, rocks and ice) that was surrounding the sun.
- Later, this sun nebula turned into a flat rotating disk, and then the dust compressed forming 4 masses: Mercury, Venous, Earth and Mars.
- In an external further zone, the ice and dust combined with gases forming : Jupiter, Saturn, Uranus and Neptune.

*Theories about the evolution of the solar system:

There are many scientific philosophical theories that explained the evolution of the solar system. The most important are:

1. Nebular assumption (Laplace 1796)
2. The crossing star theory (Chamberlain and Molten 1905)
3. The Modern theory of the world (Alfred Hale 1944)

1 Nebular assumption (Laplace 1796):

- ***This perception is affected by two observations:***
  1. There is something that looks like a cloud or a nebula in the space.
  2. The space contains many cloudy rings surrounding some planets such as the rings at Saturn
- ***Theory assumptions:***
  1. The solar system was a gaseous sphere revolving around itself, this sphere is called a nebula which gradually lost its heat and contracted in size and its revolving speed increases.
  2. Under the effect of the centrifugal force, the nebula lost its sphere form and become a flat rotating disk. Also under the same effect parts got separated from this disk and form a gaseous ring which rotate at the same direction that the nebula rotates.
  3. These gaseous rings got cooled and frozen to form the planets of the solar system. The flaming mass that remained in the centre formed the sun.

2 the crossing star theory (Chamberlain and Molten 1905):

- ***Theory assumptions:***
  1. The solar system was originally a big star which is the sun.
  2. Another huge star approached the sun.
  3. This star attracted the sun to it, which led to a great expansion in the part of the sun facing it.
  4. This expanded part was exploded and a gaseous line was formed with a great length from the sun to the last planet.
  5. The gaseous line started to condense due to the attraction forces and then cooled to form the planets.
  6. The sun escaped from the gravity of that star due to the explosion.

❸ The Modern theory of the world (Alfred Hale 1944):

➢ ***This theory based on a phenomenon which is:***

1. Sometimes a star glows for a short time to be one of the most shining stars in the sky. after a day or two its glow disappears gradually to return to its original glowing. The reason for that phenomenon is not precisely known.
2. It may be due to the explosion of the star due to nuclear reactions. So suddenly this star bombs huge amount of gaseous materials.
3. The stars size increases then the glowing increases. After the gases are cooled, its shining returns as it was.

➢ ***Theory assumptions:***

1. The existing of a star rotating near the sun.
2. The star was exposed to explosion due to huge nuclear reactions.
3. The force of the explosion led to the bombing of the star's nucleus away from the gravity of the sun.
4. A cloud of gas remained and was subjected to cooling and contraction processes forming planets.
5. The force of the sun's attraction controlled the orbits of planets around it.
6. Planets which are controlled, the determination of their orbits were evolved.

*The difference in the length of the day and year from one planet to another:

Difference in length of the year	Difference in length of the day
1. Distance between the planet and the sun. 2. Speed of the planet rotation around the sun.	1. Radius of the planet. 2. Speed of the planet rotation around its axis.

*Technological applications:

1. ***The solar telescope:***

➢ It's equipment that centered on the Earth or carried into the space in order to study the sun.

➢ The sun light is gathered then separated by spectrometer into a solar spectrum (showing the different light wavelengths emitted by the sun).

- Most of astronomer's information about the sun is from studying its spectrum.
- This telescope works on reflecting the sun rays downwards to a mirror in a tunnel under the Earth's surface, then a picture of the sun is formed in a monitoring room where astronomers can study its light.

2. ***Modern equipments:***
   - Astronomers use modern equipments not only on the Earth but also sending them to the space to get better information and pictures.
   - Telescopes rotating in orbits around the Earth can see celestial bodies more clearly, they can also catch rays able to penetrate the Earth's atmosphere.
   - Spacecrafts are send in trips to revolve around another planets or land on it sending discoveries to the Earth.
   - Most of these modern equipments are controlled by computers on the Earth's surface.
3. ***The Hubble telescope:***
   - It was launched in April 1990, and rotate around the Earth with a height 500 km.
   - From its location, it collect picture representing the history, which allow the astronomers to study the evolution of the universe after the Big Bang.
4. ***Space suits:***

   Space suits now are differs according to the mission the astronauts perform. There is a space suit to travel back and forth. There also a normal type of special clothes to be worn inside the spacecraft in its rotation.
5. ***Weightlessness:***
   - The continuous force of the Earth's gravity on our bodies gives us weight.
   - In spacecrafts the astronauts feel they are lighter as they going down in it.
   - Experiments are done on both animals and plants in space to know the effect of weightlessness on them. Also specific scientific experiments are done as they cannot be done on the Earth's surface.

Quiz ⑥

Q. (1): Complete:

1. The Earth planet belongs to a galaxy called ..... .
2. The sun takes ..... Years to complete one rotation around the centre of the galaxy.
3. After 10,000 million years of the Big Bang, ... was born and then ..... and ..... were created.
4. The ..... Is the space which contain all the galaxies, stars, planets, moons and living organisms.
5. The expansion of the universe and the merging of atomic particles creating helium and hydrogen is ..... .

Q. (2): Put (√) or (X):

1. The solar system is located in the Milky Way ( )
2. The universe emerged from the particles of the oxygen and nitrogen ( )
3. The solar system contains many stars ( )
4. Galaxies emerged after 5000 million years after the Big Bang ( )

Q.(3): Give reasons:

1. Our galaxy is called the Milky Way galaxy.
   .....
2. The distances in the universe are measured by the light-year.
   .....
3. The continuous expansion of the space.
   .....
4. The day and year time differs from one planet to another.
   .....
5. Galaxies move away from each other.
   .....

Q. (4): write a paragraph illustrating the following:

1. The crossing star theory.

.....

.....

2. The solar system.

.....

.....

3. The nebula.

.....

.....

4. The cosmic space.

.....

.....

5. The galaxy.

.....

.....

Q. (5): Complete the following paragraph using the following wards:

(universe – galaxies – the cosmic space – the Milky way – the sun – the Earth – the moon – the stars)

..... rotates around the Earth in a fixed orbit and ..... rotates around the sun once every early year. Planets rotate ..... In fixed orbits. The solar system occupies a position at the edge of ..... . we see from the surface of the Earth ..... That this galaxy contains. Galaxies is move away in ..... and this expanded ..... is a cosmic space and galaxies that contain the stars.

Unit 4: Reproduction and species continuity

Lesson 1: Cell Division

*The importance of cell division process to living organisms:

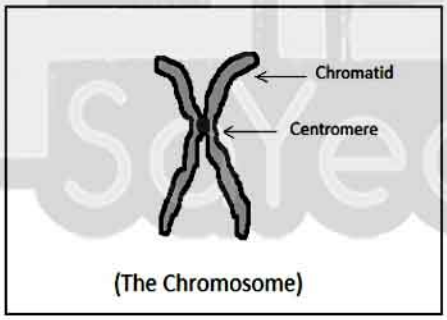
Cells in multicellular organisms are divided into somatic and reproductive cells. Each of them divided to achieve different purpose:

Somatic cells	*Reproductive cells*
They are divided by mitosis which leads to the growth of the organism and compensation the damaged cells.	They are divided by meiosis which leads to the formation of male and female gametes which are responsible for reproduction in organisms and the transfer of genetic traits from parents to their offspring.

*The part of the cell that responsible for the cell division:

- The cell nucleus contains the genetic material of the living organisms.
- This genetic material consists of a number of chromosomes which have the main role in cell division.

*General structure of chromosomes:



(The Chromosome)

- Each chromosome consists of two threads each called chromatids. The two chromatids are connected two each other in one point called centromere.
- The chromosome chemically consists of nuclear acid called DNA (which carries the genetic information of the living organisms) and protein.
- The number of chromosomes is different from one species to another, while it is constant in the same species.

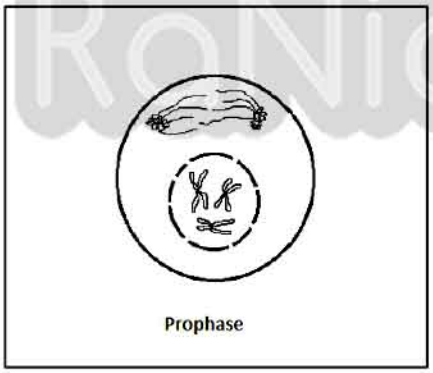
- Somatic cells contains two sets of chromosomes (one from each parent) known as the diploid number (2N), while the gametes contain only the haploid number (N).

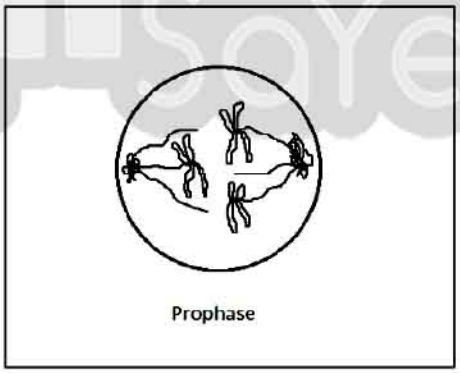
1 Mitosis:

- Occur in the somatic cells and aims to the growth of living organisms and compensation of the damaged cells.
- Before the steps of the mitosis division the cell prepare itself to the division by entering the interphase in which the amount of the DNA duplicate.
- Steps of mitosis division:

1. *Prophase:*

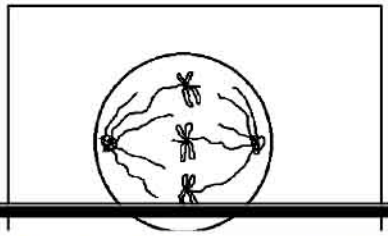
- Chromatin reticulum condenses and appears in the form of long, thin and double strings (chromosomes).
- A network of filamentous fibers called the spindles is composed extending from the two poles of the cell.
- The spindle fibers in the animal cell formed from the centrosome.
- In the plant cells, the spindle fibers are formed from the condensation of the cytoplasm at the cell poles.
- Each chromosome is connected to one spindle fiber by the centromere.
- At the end of this phase the nucleus membrane and the nucleus disappear.


Prophase


Prophase

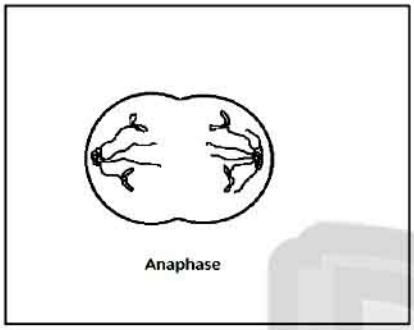
2. *Metaphase:*

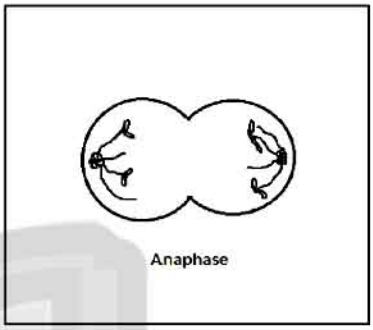
The chromosomes are arranged in the equator of the cell where they are attached to the spindle fibers with the centromere.



3.Anaphase:

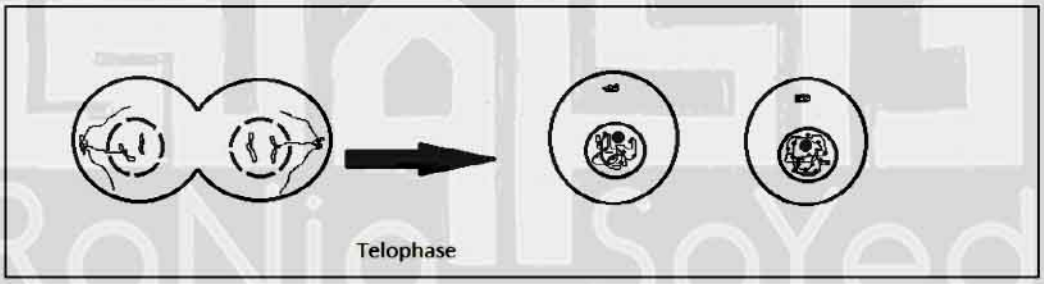
- The centromere of each chromosome splits lengthwise into two halves taking one chromatid with it.
- Spindle fibers begin to shrink, so two identical groups of chromatids are formed, each group migrate to one pole of the cell.





3. Telophase:

- A series of changes occur leading to the formation of two separate cells each one has the same chromosomes of the mother cell.

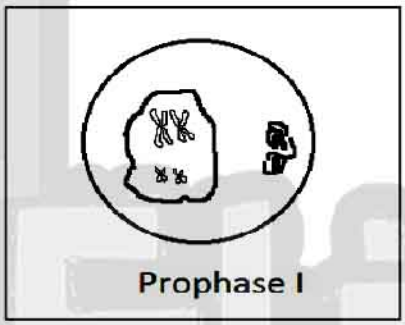


❷ Meiosis:

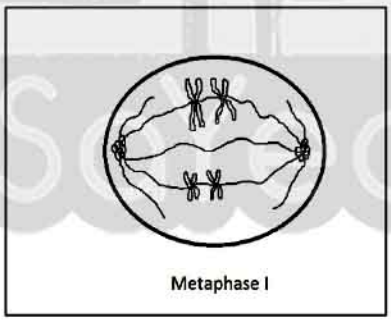
- Meiosis occurs in organisms which reproduce by gametes.
- In animals this division occurs in males in the testes to produce sperms and in females in ovary to produce the ova.
- In flowering plants this division occurs in the anther to produce the pollen grains and in the ovary to produce an egg.
- The meiosis differs from mitosis as the parent cell has only half of the chromosomes number.

- This division occurs in two stages where the chromosomes are doubled once in the interphase before the first meiotic division.
- ① *First meiotic division:*

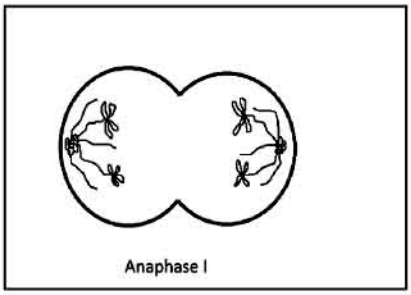
1. **Prophase I :**
   - Chromatin reticulum intensifies and appears in the form of distinct chromosomes.
   - Those chromosomes arranged in homologous pairs, each pair consists of 4 chromatids and called tetrad.
   - At the end of this phase the nuclear membrane disappears and each two chromosomes in the tetrad start to move away from each other.
   - The spindle fibers appear and the chromosomes attaches to it.


Prophase I

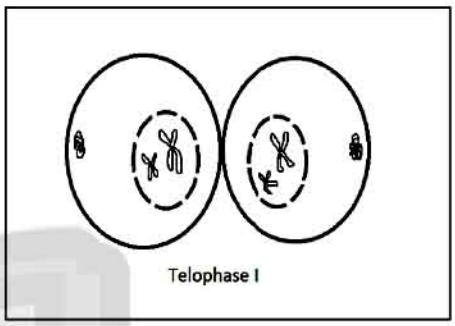
2. **Metaphase I :**
   - Chromosomes pairs arranged on the cell's equator.


Metaphase I

3. **Anaphase I :**
   - The spindle fibers shrink taking one chromosomes of the pair with it.
   - Each chromosome migrates to one pole of the cell.
   - Each pole contains half the number of chromosomes of the parent cell.


Anaphase I

4. **Telophase I :**
   - Two nuclei are formed around the two groups of chromosomes.
   - Each nucleus has half of the number of chromosomes of the parent cell.
   - Then the cell enters the second meiotic division.

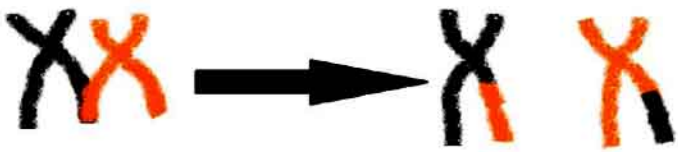

Telophase I

➢ ***②Second meiotic division:***

- It aims to increase the number of gametes that formed which contain half of the number of chromosomes of the parent cell.
- Each cell of the produced cell is divided into 2 cells by mitosis division way.
- At the end of Telophase II, 4 cells are formed each has only the half number of chromosomes of the parent cell.
- When female and male gametes are combined, the zygote is formed which contain the full number of chromosomes of the organism's somatic cell. That's why the number of chromosomes remains constant in the same species.

➢ ***Crossing Over phenomenon:***

- At the end of prophase I some pieces of the inner chromatids of each tetrad are exchanged to produce new genetic arrangements. This phenomenon is called crossing over.
- This phenomenon aims to the variation of genetic traits among the individual of the same species by genes exchanging between the two homologous chromosome's chromatids and distributing them randomly in the gametes.


Crossing Over Phenomenon

Quiz ⑧

Q.(1): write the scientific terms:

1. The part in the cell which is responsible for cell division (.....)
2. Fibers extend between the two poles of the cell in prophase. (.....)
3. It consists of two chromatids connecting together with the centomere. (.....)
4. It occurs at the end of the first prophase of the meiotic division, in which the inner parts of chromatids are exchanded. (.....)
5. The phase in which the chromosomes are arranged in the equator of the cell. (.....)

Q. (2): Compare between:

1. Somatic cells and gametes in accordance to the number of chromosomes.
2. Mitotic and meiotic divisions in accordance to the place of occurrence and the aim of division.

Q. (3): choose:

1. The cell prepare itself for the mitotic division in .....
   - Prophase
   - Interphase
   - Metaphase
   - Telophase
2. The centromere of each chromosome is divided vertically, then the two chromatids are separated from each other in the .....
   - Prophase
   - Telophase
   - Anaphase
   - Metaphase
3. The chemical structure of the chromosome is .....
   - The nucleic acid DNA
   - Protein
   - Carbohydrates
   - A,B together

Lesson 2: Sexual and Asexual Reproduction

*Reproduction:

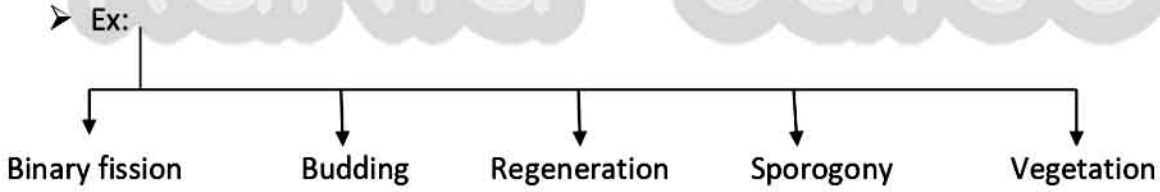
Biological process where the living organisms produces new individuals of the same kind and thus, ensuring its continuity.

*Types of reproduction:

Asexual Reproduction	*Sexual Reproduction*
Occur by only one living organism. Occur mostly in single-celled (unicellular) organisms	Occur in most higher living organisms of plants and animals Occurs through two living organisms, one of them is male and the other is female.
Ex: Budding in Yeast Binary fission in Amoeba	Ex: Reproduction in human

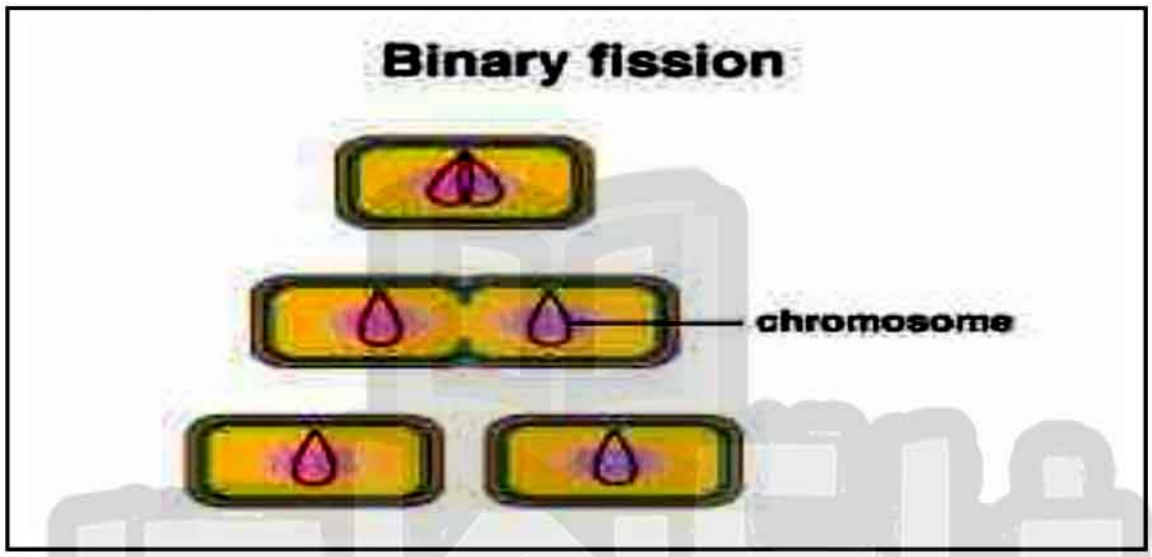
FIRST: Asexual reproduction:

- Occur mostly in the unicellular but occur also in the multi-cellular animals and plants.
- By which the living organisms produces new individuals that have genetic traits identical to the parents.
- Asexual reproduction includes mitosis and doesn't require special system or structures in the living organism.
- Ex:



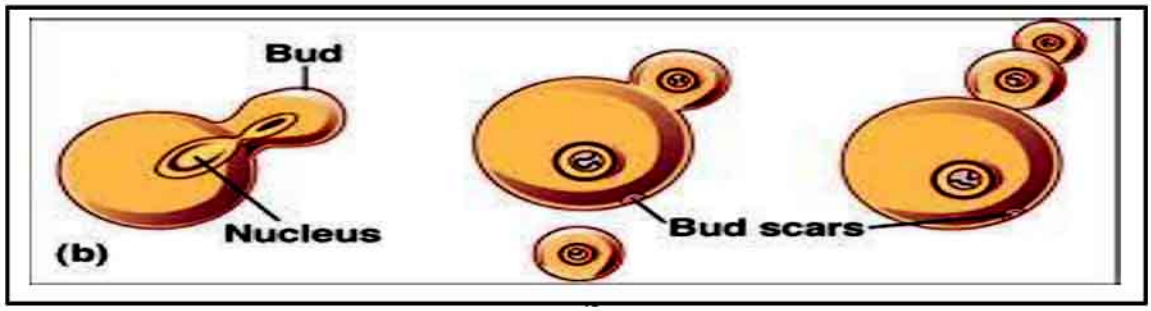
1 Binary fission:

- Occur in unicellular organisms.
- The nucleus divided into two by mitosis, then the cell (which represent the organism itself) divide to form two individuals.
- Ex: Protozoa such as **Amoeba**, **Paramecium** and **Euglena**, also found in **algae**



2 Budding:

- Occur in unicellular organisms such as **yeast** (which is a fungus), and in multicellular organisms such as Hydra and sponges.
- In Yeast:
  - The bud emerges as a lateral bulge in the cell.
  - Then the nucleus is divided into two nucleoli by mitosis.
  - One of the two nucleoli migrates into the bud and the other remains in the parent cell.
  - The bud grow gradually and remain attached to the parent cell until it's fully grown then separates from it to form a colony.



3 Regeneration:

- It is the ability of the animal to compensate the missing parts of it.
- The star fish arms could be regenerated and give out a complete animal if they contain a part of the central disc of the animal.

4 Sporogony (spore propagation):

- It is found in fungi such as bread mould and in some algae.
- These organisms have a special organ called sporangia which contains a lot of spores.
- After rupturing the sporangium wall the spores are released and form a new individual if they found the suitable environment

5 Vegetation:

- Some plants can reproduce without seeds; they can reproduce by their vegetative organs such as the leaf, the stems or even cells (by tissue culturing).
- This kind of reproduction aims to produce new plants very similar to the parent plant.

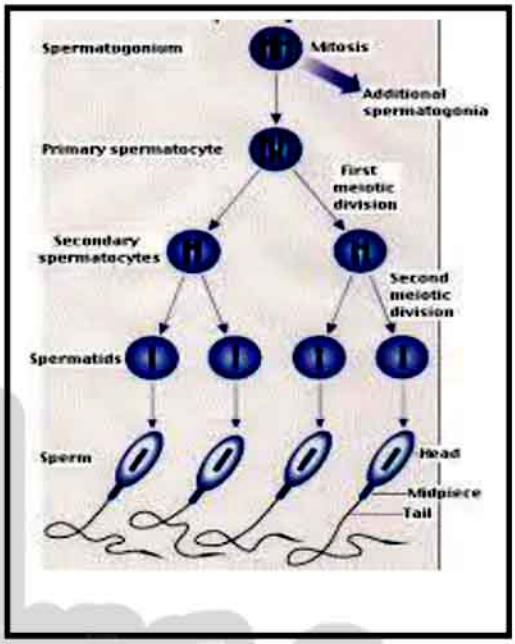
SECOND: Sexual Reproduction:

- It is the most common way of reproduction especially in the higher living organisms.
- Sexual reproduction occurs between two parental individuals, one of them is male and the other is female.

➢ **<u>It occurs through two main processes:</u>** Formation of gametes and Fertilization.

- ***Formation of gametes:***

  - Gametes are formed of cells known as the reproductive cells by meiotic division.
  - Gametes resulted from this division contain half the number of chromosomes (N) of organism's somatic cells.



- ***Fertilization:***

  - It means the combination of the female gamete (N) with the male gamete (N) to form the zygote (2N), which contains the normal number of chromosomes of the organism.
  - This zygote forms the offspring whose traits are a combination between each parent's traits.

<u>*Give Reasons:</u>

- Sexual reproduction is a source of genetic variation while asexual reproduction is not.

<u>Answer:</u>

*Asexual reproduction produce offspring identical in genetic structure to the original organism by mitosis, thus no variation is caused in the offspring as they have a full copy of the parental genetic traits.

*the offspring resulting from sexual reproduction get genetic traits from two sources, one of them is the male and the other is the female. This means that the offspring have new

genetic traits that combine the parent's traits. Thus the sexual reproduction is a source of genetic variation.

*Technological applications:

1- Nanotechnology and cancer treatment:

- Cancer occurs when the body cells are divided continually without controlling. The mass resulting from this division is called the tumor.
  - Using nanotechnology, scientists have developed smart microscopic bombs that penetrate the cancer cells and explode them from inside.
  - These bombs used to kill the cancer cells in experimental mice and prolong its life to 300 days, while the mice which didn't get the treatment lived only for 43 days.
- The Egyptian scientist Dr. Mustafa El Said discover a way to detect the cancer cells:
  - The technical starts with loading proteins (which have the ability to attach to the cancer cells secretions) with the NANO-molecules of gold and then injecting them into the patient.
  - The infected cell surface proteins get intertwined with the golden molecules to make it possible to monitor the infected cells through a microscope; each one separately.
  - The method of treatment is focusing laser with a certain degree to the gold molecules. Then it absorb the light and converts it into heat which leads to burn and kill the infected cells that has stuck to them.

2- Liver transplantation:

- Some cells in the human body don't divide at all such as nerve cells and red blood cells.
- Some cells don't divide in normal conditions but they retain the ability to divide under certain circumstances such as liver cells.
- For example: if the liver is injured or a part of it is cut, the remaining cells undergo division so as to compensate the missing parts. This is the scientific basis used in liver transplantation.

Quiz ⑨

Q. (1): Explain by drawing, how are gametes produced by sex cells through the meiotic division.

Q. (2): Sexual reproduction is a source of genetic variation..... **Explain**.

.....

.....

.....

Q. (3): write the scientific terms:

1. The process in which the living organism produces new individuals carries genetic traits identical to their parents. (.....)
2. The most common asexual reproduction in fungi and algae (.....)
3. It has genetic material from both parents and during growth gives new individual carries the traits of both parents. (.....)
4. A type of asexual reproduction occur in yeasts and sponges (.....)
5. The ability of some animals to compensate the missing parts. (.....)

GOOD LUCK